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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/611,797	06/30/2003	Bradley J. Aitchison	11429/17:2	5087

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EXAMINER	
NOVACEK, CHRISTY L	
ART UNIT	**PAPER NUMBER**
2822	

DATE MAILED: 11/26/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/611,797	AITCHISON ET AL.	
	Examiner	Art Unit	
	Christy L. Novacek	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 July 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 July 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/16/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the amendment filed July 29, 2004.

Drawings

The replacement drawing was received on July 29, 2004. This drawing is approved.

Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1, 2, 4-7, 11, 14-19 and 23-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lim et al. (US 6,570,253)

Regarding claims 1, 15, 16 and 25-32, Lim discloses a first electrode (840), a dielectric structure (100) including a substantial amount of niobium oxide (Nb_2O_5) deposited over the first electrode, a current leakage inhibiting layer (110) having a thickness of "from several angstroms to dozens of angstroms", and a second electrode deposited over the dielectric structure (850) (Fig. 6-8; col. 4, ln. 18-26; col. 8, ln. 1 - col. 9, ln. 51). Lim does not explicitly disclose that the dielectric structure has an overall capacitance density of greater than 25 nF/mm^2. However, the dielectric structure is formed in the same way as Applicant's dielectric structure, wherein layers of aluminum oxide are alternated with layers of niobium oxide that have been deposited using ALD such that the layers have a thickness of anywhere from several angstroms to dozens of angstroms. Therefore, it appears that the dielectric structure of Lim would inherently possess the function of having a capacitance density of greater than 25 nF/mm^2. See *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971) "where the Patent Office has reason to

believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on "); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103).

Regarding claims 2 and 17, Lim discloses the dielectric structure is a multilayer structure and the current leakage inhibiting layer may include a layer of aluminum oxide (Al_2O_3) that is "dozens of angstroms" thick and the niobium oxide layer is deposited overlying the layer of aluminum oxide (col. 4, ln. 18-26).

Regarding claim 4, Lim discloses the dielectric structure is a multilayer structure and the current leakage inhibiting layer may include a layer of zirconium oxide (ZrO_2) that is "dozens of angstroms" thick (col. 9, ln. 28-36).

Regarding claim 5, Lim discloses the dielectric structure is a multilayer structure and the current leakage inhibiting layer may include a layer of silicon oxide (SiO_2) that is "dozens of angstroms" thick (col. 9, ln. 28-36).

Regarding claims 6 and 7, Lim does not explicitly disclose that the dielectric structure has an overall capacitance density of greater than 30 or 50 nF/mm^2, nor that the leakage current density is less than $1.0x10^{-7}$ $amps/cm^2$. However, the dielectric structure is formed in the same way as Applicant's dielectric structure, wherein layers of aluminum oxide are alternated with layers of niobium oxide that have been deposited using ALD such that the layers have a

thickness of anywhere from several angstroms to dozens of angstroms. Therefore, it appears that the dielectric structure of Lim would inherently possess the function of having a capacitance density of greater than 30 or 50 nF/mm^2 and a leakage current density of les than $1.0x10^{-7}$ $amps/cm^2$. See *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971) "where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on "); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103).

Regarding claims 11 and 24, Lim discloses the dielectric structure is formed by ALD (col. 5, ln. 17-21).

Regarding claims 14 and 23, Lim discloses the dielectric structure is a multilayer structure and the current leakage inhibiting layer includes at least two separate layers of a current leakage inhibiting material and at least one layer of niobium oxide (Nb_2O_5) interposed between the layers of current leakage inhibiting material (col. 8, ln. 5-60).

Regarding claim 18, Lim discloses forming a protective cap layer (aluminum oxide) over the current leakage inhibiting material and the niobium oxide via ALD.

Regarding claim 19, Lim discloses forming a lower electrode over the substrate before depositing the current leakage inhibiting material and the niobium oxide.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lim et al. (US 6,570,253) in view of Won et al. (US 6,653,186).

Regarding claim 3, Lim discloses the dielectric structure is a multilayer structure and the current leakage inhibiting layer may include aluminum oxide or tantalum oxide. However, Lim does not disclose that the current leakage inhibiting layer may include hafnium oxide. Like Lim, Won discloses a capacitor which has a dielectric layer in between the upper and lower electrodes and the dielectric layer may include aluminum oxide or tantalum oxide. Won discloses that in addition to aluminum oxide or tantalum oxide, the capacitor dielectric layer (current inhibiting layer) may include hafnium oxide (HfO_2) (col. 4, ln. 26-38). At the time of the invention, it would have been obvious to one of ordinary skill in the art to substitute hafnium oxide for the aluminum oxide or tantalum oxide of Lim because Lim teaches that a variety of different dielectric materials may be used and Won teaches that hafnium oxide may be substituted as an equivalent for aluminum oxide or tantalum oxide.

Claims 8 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lim et al. (US 6,570,253) in view of Ishibashi et al. (US 6,150,690).

Regarding claims 8 and 20, Lim discloses that the niobium oxide may be deposited against the electrode but Lim does not disclose of what material electrode is made. Like Lim, Ishibashi discloses a capacitor which has a dielectric layer in between the upper and lower

electrodes and the dielectric layer may include tantalum oxide (col. 4, ln. 18-30). Ishibashi discloses that an upper or lower electrode made of NbN can successfully be used with such a dielectric layer (col. 12, ln. 4-12). At the time of the invention, it would have been obvious to one of ordinary skill in the art to form the upper or lower electrode of Lim of NbN because Lim does not teach any particular material from which the lower electrode must be made, and Ishibashi teaches that an upper or lower electrode made of NbN can be successfully used with a dielectric layer made of tantalum oxide.

Claims 9 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lim et al. (US 6,570,253) in view of Basceri et al. (US 6,586,796).

Regarding claims 9 and 21, Lim discloses that the niobium oxide may be deposited against the electrode, but Lim does not disclose of what material the lower electrode is made. Like Lim, Basceri discloses a capacitor which has a dielectric layer in between the upper and lower electrodes and the dielectric layer may include aluminum oxide or niobium oxide (col. 4, ln. 18-30). Basceri discloses that a lower electrode made of WN or TaN can successfully be used with such a dielectric layer (col. 3, ln. 58-67). At the time of the invention, it would have been obvious to one of ordinary skill in the art to form the lower electrode of Lim of WN or TaN because Lim does not teach any particular material from which the lower electrode must be made, and Basceri teaches that a lower electrode made of WN or TaN can be successfully used with a dielectric layer made of aluminum oxide or niobium oxide.

Claims 10 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lim et al. (US 6,570,253) in view of Lin et al. (US 6,593,180).

Regarding claims 10 and 22, Lim discloses that the niobium oxide may be deposited against the electrode, but Lim does not disclose of what material the electrode is made. Like Lim, Lin discloses a capacitor which has a dielectric layer in between the upper and lower electrodes and the dielectric layer may include niobium oxide (col. 3, ln. 45-61). Lin discloses that an electrode made of platinum (Pt) can successfully be used with such a dielectric layer (col. 3, ln. 58-67). At the time of the invention, it would have been obvious to one of ordinary skill in the art to form the electrode of Lim of Pt because Lim does not teach any particular material from which the electrode must be made, and Lin teaches that an electrode made of Pt can be successfully used with a dielectric layer made of niobium oxide.

Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lim et al. (US 6,570,253) in view of Gutsche et al. (US 6,693,016).

Regarding claims 12 and 13, Lim does not disclose what the first and second electrode are made of nor the way in which the electrodes are formed. Lin does disclose that the dielectric structure is formed by ALD. Like Lim, Gutsche discloses a capacitor which has a dielectric layer such as Al_2O_3, Zr_2O_3, TiO_2, and Ta_2O_5 deposited by ALD in between the upper and lower electrodes (col. 6, ln. 49 – col. 8, ln. 10). Furthermore, Gutsche teaches that both upper and lower electrodes to be used in conjunction with these dielectric layers, may also be deposited by ALD (col. 6, ln. 49 – col. 8, ln. 10). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use ALD to deposit the upper and lower electrodes of the capacitor of Lim in a single processing cycle of an ALD reaction chamber because Lim discloses using ALD to deposit the capacitor dielectric structure and using the same deposition process to form both the electrodes and the dielectric structure, as is taught by Gutsche, simplifies the

fabrication of the capacitor as well as provides greater efficiency in the throughput of the semiconductor chip, as opposed to using two or three different processes in two or three separate reaction chambers and processing cycles to deposit the lower electrode, the dielectric structure and the upper electrode.

Response to Arguments

Applicant's arguments filed July 29, 2004 have been fully considered but they are not persuasive.

Regarding the rejection of claims 1, 16, 27 and 30 as being anticipated by Lim, Applicant argues that not all of the embodiments taught by Lim inherently have the limitations of the particular range of capacitance densities and leakage currents recited by Applicant's claims. The basis of the Examiner's position that the structure of Lim would inherently possess these limitations is that Lim using materials (dielectric layers) having the same composition as those of the Applicant and Lim also discloses forming these material layers to have a thickness within a range that overlaps that of the Applicant. In the arguments, Applicant states, "For example, *some* of the dielectric structures proposed by Lim et al. have a leakage current inhibiting layer thicker than 45 angstroms and, thus, may not achieve a capacitance density of greater than 25 nF/mm^2. Similarly, *some* of the dielectric structures proposed by Lim et al. have an overall thickness of less than 49 angstroms and, thus, may not achieve the low leakage current densities claimed by applicant." (emphasis added). Applicant's position seems to be that some of the embodiments Lim teaches do meet the claimed capacitance densities and leakage currents and some don't. Disclosure of some embodiments which may not inherently possess these limitations does not preclude anticipation when the disclosure also recites embodiments that do

inherently possess these limitations. Applicant has provided no evidence that the capacitor of Lim having the materials with the thicknesses deposited in the range recited by both Lim and Applicant fails to inherently possess the capacitance densities and leakage currents claimed by Applicant. Thus, the rejections of these claims are maintained.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN
November 15, 2004

AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
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